The Brain and Behavior

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An Introduction to Behavioral Neuroanatomy

Fourth Edition

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To our wives,
Jane (D.L.C.), Sylvia (N.N.B.), and Mary (M.F.M.)
And to our children,
Jennifer, Julie, and Amy (D.L.C.)
Tammer and Alexandria (N.N.B.)
Paul and Mark (M.F.M.)

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Preface to the Fourth Edition

This text is intended as an introduction to the complexity of human brain anatomy in a simplified form. Structures emphasized are those that are involved in behaviors important to the clinician. The veritable tsunami of functional imaging studies of the brain in humans published in the past six years has contributed greatly to the understanding of the role played by various parts of the brain. Imaging techniques have evolved to provide a much more detailed view of brain structure. In addition, diffusion tensor imaging now allows a view of the relative integrity of white matter neural pathways. Paralleling the volume and resolution of detail is the gradual realization that brain function is more complex than previously understood. This has made our goal of a simple, easy-to-read introduction to clinical neuroanatomy more difficult. As with previous editions, our attempt to present function in a simplified voice is prone to distortion. To aid the reader from straying too far off the path we have provided numerous references to give an opportunity for a more in-depth look at the subject in question.

We have made many changes and additions. Several of the chapters on cortex are completely rewritten. For example, our understanding of the cingulate cortex has dictated a move from a two-part model to a four-part model with subdivisions. A number of the accompanying illustrations in earlier editions have been removed and new ones added to match the updated content. We introduced the concept of brain networks in the third edition as a group of brain regions that interact together. This edition provides an introduction to more than ten networks. We have also expanded the sections on clinical considerations. This reflects the publication of more detailed studies involving larger numbers of patients with specific disorders. In several cases the studies have sampled brain activity at several points in time, providing a sense of changes in brain anatomy and function over years.

Abbreviations

5-HT	5-hydroxytryptophan (serotonin)
AC	Anterior commissure
ACC	Anterior cingulate cortex
ACh	Acetylcholine
AChE	Acetylcholinesterase
ACTH	Adrenocorticotropic hormone
AD	Alzheimer disease
ADHD	Attention-deficit hyperactivity disorder
AFP	Anterior face patch
AI	Anterior insula
AIC	Anterior insular cortex
AIPA	Anterior intraparietal area
aIPS	Anterior intraparietal sulcus
aMCC	Anterior midcingulate cortex
AMH	Anti-Mullerian hormone
AMPA	α-amino-3-hydroxy-5-methyl-4-isoxazole proprionate
AN	Anterior nucleus
APS	Anterior perforated substance
ARAS	Ascending reticular activating system
ASD	Autism spectrum disorder
ASP	Aspartate
ATP	Adenosine triphosphate
BA	Brodmann area
BDNF	Brain-derived neurotropic factor
BLa	Basolateral cell group of the amygdala
BNST	Bed nucleus of the stria terminalis
BOLD	Blood-oxygen-level dependent
BP	Bipolar disorder
BPD	Borderline personality disorder
bvFTD	Behavior variant frontotemporal dementia
CA	Cornu ammonis
CC	Corpus callosum
CeM	Centromedial cell group of the amygdala
CEN	Central executive network
CFP	Cingulo–frontal–parietal
Ch	Cholinergic cell group
cIPS	Caudal intraparietal sulcus
CNS	Central nervous system
CRH	Corticotropin-releasing hormone
CSF	Cerebrospinal fluid
CT	Computed tomographic
$D_{1,\,2}$	Dopamine receptors type 1 and 2
DA	Dopamine
dACC	Dorsal anterior cingulate cortex
dAIC	Dorsal anterior insular cortex
DBS	Deep brain stimulation
DB_v	Diagonal band of Broca, vertical limb
DFPAN	Dorsal Frontoparietal Attention Network
DG	Dentate gyrus
DLPFC	Dorsolateral prefrontal cortex
DMN	Default mode network
DMPFC	Dorsomedial prefrontal cortex
dPCC	Dorsal posterior cingulate cortex
DTI	Diffusion tensor imaging
DWI	Diffusion-weighted imaging
EC	Entorhinal cortex
E-LTP	Early long-term potentiation
EPI	Epinephrine
EPSP	Excitatory postsynaptic potentials
FA	Fractional anisotropy
FEF	Frontal eye field
FFA	Fusiform face area
FLAIR	Fluid attenuated inversion recovery
FTD	Frontotemporal dementia
GABA	Gamma-aminobutyric acid
GCS	GLY cleavage system
GLU	Glutamate
GLY	Glycine
GP	Globus pallidus
GPe	Globus pallidus external segment
GPi	Globus pallidus internal segment
GTS	Gilles de la Tourette syndrome
Hb	Habenula
HIV	Human immunodeficiency virus
HPA	Hypothalamic–pituitary–adrenal
ICG	Intercalated cell groups of the amygdala

INAH	Interstitial nucleus of the anterior hypothalamus
IPL	Inferior parietal lobule
IPN	Interpeduncular nucleus
IPS	Intraparietal sulcus
LC	Nucleus locus coeruleus
LD	Lateral dorsal nucleus
LDt	Laterodorsal tegmental nucleus
LEC	Lateral entorhinal cortex
LGB	Lateral geniculate body
L-LTP	Late long-term potentiation
lPOA	Lateral preoptic area
LS	Lateral septum
LTN	Lateral tuberal nucleus
LTP	Long-term potentiation
MAP	Mental and physical
MB	Mammillary body
MCC	Midcingulate cortex
MCI	Mild cognitive impairment
MD	Mediodorsal nucleus
MEC	Medial entorhinal cortex
MGB	Medial geniculate body
MI	Massa intermedia
MIPA	Medial intraparietal area
mIPS	Middle intraparietal sulcus
MLF	Medial longitudinal fasciculus
MPFC	Medial prefrontal cortex
mPOA	Medial preoptic area
MPTP	1-methyo-4-phenyl-1,2,3,6-tetrahydropyridine
MRI	Magnetic resonance imaging
MS	Medial septum
MST	Medial superior temporal area
MT	Middle temporal visual area (V5)
MTLE	Medial temporal lobe epilepsy
NAc	Nucleus accumbens
NE	Norepinephrine
NMDA	N-methyl-D-aspartate
NREM	Non-rapid eye movement
NST	Nucleus of the solitary tract
OC	Optic chiasm
OCD	Obsessive-compulsive disorder
OFC	Orbitofrontal cortex
pACC	Pregenual anterior cingulate cortex
PAG	Periaqueductal gray
PbN	Parabrachial nuclei
PCC	Posterior cingulate cortex
PD	Parkinson disease
PET	Positron emission tomography
PFC	Prefrontal cortex
PHC	Parahippocampal cortex
PIC	Posterior insular cortex
pMCC	Posterior midcingulate cortex
PNS	Peripheral nervous system
POA	Preoptic area
PPA	Parahippocampal place area
PPN	Pedunculopontine nuclei
PPRF	Paramedian pontine reticular formation
PRC	Perirhinal cortex
PTg	Pedunculopontine tegmental nucleus
PTSD	Posttraumatic stress disorder
Pul	Pulvinar
PVN	Paraventricular nucleus
RBD	Rapid eye movement behavior disorder
REM	Rapid eye movement
RSC	Retrosplenial cingulate cortex
sACC	Subgenual anterior cingulate cortex
SAD	Seasonal affective disorder
SB	Social brain
SCN	Suprachiasmatic nucleus
SEF	Supplementary eye field
SI	Primary somatosensory cortex
SII	Secondary somatosensory cortex
SMA	Supplementary motor area
SMC	Supplementary motor complex
SN	Salience network
SNpc	Substantia nigra pars compacta
SPL	Superior parietal lobule
STG	Superior temporal gyrus
STS	Superior temporal sulcus
SWS	Slow-wave sleep
SZ	Schizophrenia
TBI	Traumatic brain injury
TIA	Transient ischemic attack
TMS	Transcranial magnetic stimulation
ToM	Theory-of-mind
TP	Temporal pole
TPJ	Temporoparietal junction
UF	Uncinate fasciculus
V1	Primary visual cortex
V2	Secondary visual cortex
V3	Tertiary visual cortex
V4	Quaternary visual cortex
VA	Ventral anterior nucleus
vAIC	Ventral anterior insular cortex
VL	Ventral lateral nucleus
VLPFC	Ventrolateral prefrontal cortex
vPCC	Ventral posterior cingulate cortex
VPL	Ventral posterolateral nucleus
VPM	Ventral posteromedial nucleus
VTA	Ventral tegmental area